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Arrangement for active oscillation damping

The invention relates to an arrangement for the active oscillation damping of a mass opposite a vibrator with to a source of oil connected hydraulic ram/cylinder device, which is on the one hand mechanical coupled with the mass and on the other hand with the vibrator, further with a level control loop for the distance between measures and vibrators and with oil pressure-controlled acceleration sensor.

The active attenuation of masses has the substantial advantage opposite a passive attenuation acting in connection with a spring assembly that a spring in the connection can be void between vibrators and measures. The abolishment of the spring is favourable in various respect: Significant one in this connection is on the one hand that that amplifier acre kungsfaktor the system, i.e. the ratio of the acceleration of measures as the value 1 small to vibrator in each case is, during it due to the natural frequency the spring into also values regular with passive attenuation contains fitted with springs system, which are appropriate for significant over the "1". On the other hand is of importance, since the magnitude of the measures supported opposite the vibrator can become within wide limits varied, without affecting the Dämpfungseigenschaften of the arrangement, while a fitted with springs system brings problems in these cases themselves with itself if the Federkennlinie with mecha niches means becomes influenced.

An active attenuation is costlier than a passive damped system with springs and cannot find therefore not in all cushioned systems use; it has to protect their authority however, where extreme good damping characteristics are from substantial importance, in particular thus, where cs into it goes, to rien men grain-damaging accelerations and vibrations. The bottom term "stabilized platform" o.a. active absorption systems are in addition, in the navigation and in the weapon technology of importance.

There is active dampers known, which work on elektronischem and electromechanical path. Ilier are those relationship moderate high A; > parativen expenditures and the impact sensitivity of such arrangements in some application fell tjnangenelnj. Known one is further eih active damper, which measures the accelerations electronic and which to vapors into hydraulic energy converts so gained signals. For paths of the electronic component before the saying applies, wengj calibrates such a kumbinierter damper contrary to pure electronic/electromechanical arrangements already larger measures to absorb can.

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Further a pure hydraulic arbeitender active damper known is, that on hydraulic path the movement and the position of a comparison mass scans and the so gained Signal in addition used too däm pfende Mdsse adjusted elie on hydraulic path. Her this state of the art is it adverse that the comparison mass to the size rung the tax ways at the hydraulic Abtsten with a Hebelübersetzung work must, so that the attenuation of the system of the magnitude of the frictional forces can become negative Influenced within the hebelübertragung and of their mechanical oscillation inclinations. These known dampers serves for the stabilization of driver's seats for example from @andwirtschaftlichen Ackenschleppern. With such applications however considered must become that that does not only @ährt the rockers formed vehicle in the plane, but also slopes to master must, whereby the function of the Vergleichsmasse is beein@lusst. In addition it is with the bekannten active damper schwierigel to adapt it to different large masses which can be absorbed which result from unterschiedlichen operator's weights.

The invention is therefore the basis the object, which becomes known hydraulic active damper so weiterzubilden that the disadvantages resultant from the use of the comparison mass besetztg itself, at least however reduced.

On the basis of an arrangement for @ktiven oscillation damping measures opposite a vibrator with one to an oil liquid manure angeschlossenen hydraulic piston cylinder device, which is on the one hand with the measures un on the other hand coupled mechanical with that rockers, further with a level control loop for the distance between mass and vibrator and with oil pressure-controlled acceleration sensor, consist the solution according to invention of it that the working cylinder of the pistons/cylinder device possesses at least two axial offset, from the working piston gesture ores Austässe, from those at least a permanent with the source of oil and over a counter-pressure guard (positive pressure valve) permanent or beschleunigungsabhängig with the oil sump connected and/or. connectable and of those min destens another acceleration-dependent over a valve with the oil sump is more connectable.

The advantage of this solution exists: more primary in the fact that it one comparison-measured any longer does not require. The damper according to invention compares does not mcht an hydraulic giving pressure with the fixed comparison mass, but the Vorgebdruck more immediate with the mass which can be absorbed. It is favourable in addition that the damper according to invention with simple means can become either manual or also automatic, adapted to different those which can be absorbed measures, without its damping characteristics became thereby influenced. It comes that the structural effort small held becomes katin A @ as hei < leni known @kt ivelt Dätnp more fer the inventive arrangement to the active Schwing@ngs absorption can with distributes on all fields inested to become, which come for an active attenuation at all into question and which were addressed in quossen trains foregoing. Only for example the attenuation of operator's cabs of trucks and agricultural vehicles or their seats is erhöht, more conceivable also the use at Rüttelverdichterh or to the stabilization of platforms is in military vehicles. The inventive arrangement is not in the rest of on the attenuation toward the Schwerkraftwirkung limited, so that possible with use of mebrerer dampers without welters a stabilization is in three to each other vertical standing directions, whereby the magnitude of the measures of untargeordneter importance, which can be absorbed, and a change of the mass without Ande are large range possible.

The foregoing umr i ssene Erfindungsgedanke permits a large number of arrangement possibilities. Advantage clings to out and developments results from the appended Beschreibung and from the claims.

The invention is appended althatt@d also the embodiments more near explained represented in the designs. From the designs show:

Fig. 1 a first embodiment of the active

Damper in form of a cylinder also

A edge control and external pressure regulating valves;

Fig. 2 a modification of the embodiment ge. 1;

Fig. 3 another embodiment of the active damper with two-edge control and likewise external disposed Drtlckregel valves; Fig. 4 a third variant dampers with two edge control and simple acting Zylin that; ;

Fig. 5 one the Fig. 4 similar active damper with inte (; rierter pressure regulation in compact Ausführun < ;

Fig. 6 and 7 two of the embodiments in accordance with Fig. 4 similar

Variants of the damper with more modified

Control;

Fig. 8 another Ausführtritsform of an active

Damper after the invention with simple we kendem, double applied cylinder also

Square control;

Fig. 9 an embodiment of the damper, that the early in accordance with Fig. resembles 8; and

Fig. 10 the embodiment of an active damper with double acting cylinder and squares control.

It is pointed out first that in the appended description of figure all same, similar or in their action comparable details are provided with same numerals to a large extent, in order to facilitate the respective association between the different embodiments. Further it is to be pointed out that all embodiments of the active damper external in the form of normal pistons/cylinder arrangements with working cylinder 12, piston 20, piston rod 21 and with blivets are 22 at the floor of the cylinder 10 as well as 22 at the end of the piston rod 21 shown; the terminal of the damper both to the vibrator as well as to likewise the mass, not represented (not represented in the designs, in the drawing can happen with the help of the eyes 12, 22, however are others (e.g. rigid) connections in same way possible.

In the cylinder 10 three annular grooves are in axial distance, from which the annular groove 14a sits at the floor of the cylinder and possesses an outward leading terminal P, from which the annular groove 14b axial offset is in the direction of the center of the cylinder and is over an outward leading terminal P1 ordered and from those the annular groove 14c in the range the cylinder 10 of a final lid 11 provided and possesses an outward leading terminal T. The lid 11 is perforated in conventional manner and serves the guide of the piston rod 21, to whose seal it is with an O ring mistake.

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The piston 20 has an axial length, which is larger as the axial distance of the annular grooves 14a, 14b. Its floor of the cylinder course-turned side forms a tax edge 24a, which cooperates with the annular groove 14b in the appended still beschriebenen manner. The cylinder space between the piston and the floor of the cylinder is designated with I.

A pump 80 forms the source of oil of the hydraulic system. The pump 80 sucks in 91 into a conduit 88, which leads 10 and on the other hand to a terminal P of a pressure monitor on the one hand to the terminal P of the cylinder in form of an upper pressure control valve 70 from a sump 84 oil, presses it by a non return valve 72 along a conduit. The pressure monitor is for example adjusted on a value of 100 bar with the help of a manual operable actuator and ensures for the fact that in the conduit 88 and with this over the terminal P and the annular groove 14a will maintain connected the cylinder space I essentially a constant pressure of (for example 100 bar). As soon as the pressure in line 88 exceeds the set value, the oberdruck opens valve 70, so that excess oil arrives over the output T of the upper pressure control valve at the return a formed conduit 93 and from there over a non return valve 82 back into the sump 84. The upper pressure control valve 82 is in the embodiment adjusted on an opening pressure of 1 bar, so that in the Icklaffleitung 93 a entsprechender form will maintain.

The Rinyut 14b located in the cylinder 10 likewise is over its terminal P1 and an upper run line 92 to a pressure monitor in form of an upper pressure control valve 71 with an input P and an output T connected. The output T is for his part 93 connected with the return line, and the relief valve 71 is likewise manual on a desired ofussdruck more

adjustable, which amounts to in the embodiment 90 bar.

The return line 93 is over the two outputs T of the pressure monitors 70, 71 outside up to the terminal T of the cylinder 10 guided, which is with the annular groove 14d connected.

The before described simplest embodiment is based - like all other embodiments - on the principle to hold within an hydraulic cylinder the pressure of the hydraulic fluid independent from the external forces to a large extent constant and depending upon direction of the outside between cylinders and piston rod forces hydraulikflüssigkeit with relative small Druckschwankungen from the cylinder to exhaust or this supply. The respective deflection is thereby a level control superposed, returned by means of which the mass which can be absorbed becomes after an outside application of force into their output plane, this output plane corresponds to a constructional predetermined relative position of cylinder 10 and piston rod 20, which are in all drawing figures designated as "Mittellager" and are in case of the fig 1 in the plane, the tax edge course-turned by those the cylinder soil the annular groove 14b defined becomes.

The embodiment in accordance with Fig. 1 works as follows: If the piston 21 toward de Pfeiles U accelerated becomes, the pressure in the cylinder space I rises beyond the measure predetermined by the pressure monitor 70. The pressure monitor 70 lets oil divert into ücklaufleitung the 93, so that itself the piston rod toward the arrow U so long downward moved, until the acceleration became again 0.

In this moment the upper pressure control valve 70 closes, so that the cylinder space I of the pump becomes 80 again filled with fresh oil. The sequence is a movement of the piston 20 upward toward the arrow 0, so far, until the tax edge 24a of the piston of the associated tax edge of the annular groove 14b becomes released. In this moment the oil diverts 71 into the return line 93 by the upper run line 92 and the upper pressure control valve adjusted on a lower value. The piston 20 adjusts itself thus to the constructional central position, which the bottom piston corresponds to the balance between the pressure and the mass connected to the piston rod 21 (not shown).

If the piston rod 21 an acceleration affects toward the arrow 0, reduced itself the pressure in the cylinder space I with the sequence that the pump promotes 80 more oil there and for the pistons 20 to direction of arrow 0 upward pushes. The oil in the there cylinder space II, located above the piston 20, arrives thereby over the terminal T of the annular groove 14d into the return line 93 and from there other into the sump 84. Against end of the acceleration already flowed oil begins by the upper run line 92 and the upper pressure control valve 71 into the sump abzuströmen into the cylinder space I, and as soon as the acceleration has the value 0 achieved, piston rod 21 with piston 20 sets itself displaced thereby so long oil downward in direction of arrow U in Bewegung. Der piston over the overflow pipe 92, until its tax edge 24a stands again in the central position.

In this moment the system is again in the balance.

The simplicity of this damper follows from the application of the a edge control as well as the use of the two external and manual adjustable pressure monitors 70, 71. Preferred one becomes this embodiment if essentially constant masses in vertical Richtung damped to become to be supposed, because it is missing here at an automatic pressure adjustment to schwingende masses. It describes is still pointed out that in this description of figure assumed becomes that the mass with the piston rod 21 and the vibrator with the cylinder, which can be absorbed, is 10 coupled. Depending upon magnitude of the measures which can be absorbed the pressure monitor 70 manual is to be adjusted in such a way that the piston 20 stands with acceleration-free mass in the central position. The associated adjustment of the upper pressure control valve 70 certain then in addition the active upward movement of pistons also on it quiescent mass at the lower end position of the piston up to the central position. The adjustment to those Overflow pipe 92 connected second Vberdruckven tilis 71 certain in contrast to this the passive downward movement of pistons and measures from the driven out end position up to the central position. Die vorgesehene Druckdifferenz in der Einstellung der beiden Ventile 70, 71, die in diesem Ausführungsbeispiel ca. 10% amount to, serve the level control and are jointly responsible for the fact that the damper stands in the acceleration-free state in its central position.

While 82 achieved with the upper pressure control valve it becomes that in the cylinder space II of all piston movements to a large extent independent always prevails a predetermined backpressure >, the valve 72 located in the pressure line 91 on the function of the active Dant; fers keinen Einfluss. It is only ensure that the piston drives with a failure of the pump 80 into its inner end position.

In Fig. 2 represented embodiment differs from the active damper in accordance with Fig. 1 only slight in the hydraulic circuit outside of the cylinder 10. The difference lies in the fact that in place of the upper pressure control valve 70, that in case of the Fig. 1 of the conduit 88 to the return line 93 leads, an upper pressure control valve and/or. Pressure monitor 70a provided is, which connects the conduit 88 with the overflow pipe 92.

The upper pressure control valve 70a is adjusted on a relatively small Oberdruck, because it lies due to the described circuit now in series to the relief valve 71.

If the sum of the adjusted excess pressures with the valves 70a and 71 the same adjusted excess pressure of the valve 70 in case of the Fig. 1, then is the active pressure in the cylinder space I in case of the circuit in accordance

with Fig. 2 unchanged opposite the circuit in accordance with Fig. 1 thus is with in Fig. 2 active damper shown the adjustment of the relief valves 70a and 71 for the active upward movement of the piston 20 from its brought in end position to the central position determining. Like also in the case of the Fig. 1, the certain adjustment of the relief valve 71 the passive downward movement of piston 20 with associated mass from the driven out end position up to the central position.

Concerning the remaining functions including the levels regulation becomes on the embodiments the damper in accordance with Fig. 1 respect taken.

In Fig. 3 is an active damper using a simple acting cylinder with two-edge control, in all other respects with a circuit of the external valves in accordance with Fig.

2 shown.

In constructional respect the here used cylinder 10 differs from the before described by the fact that the annular grooves 14a and 14b with associated terminals P and PI the axial sen in the direction of the free end of the cylinder offset are. The piston 20 exhibits a turning off, a fixed Ringrau 24 the defined. Those the free end of the piston course-turned boundary wall of the annular space 24 represents here the tax edge 24a, while a second tax edge 24b at the free end of the piston is 20 provided. The two tax edges cooperate with in each case a boundary wall of the annular grooves 14a, 14b in such a manner that both annular grooves are in the constructional central position of the active damper of the piston 20 covered. The piston 20 possesses further one of its free end from inward axial longitudinal blind bore 27, which leads to the range of the annular space 24 and is 24 connected by at least one balance drilling 28 with the annular space. In this way a free passage for the oil of the cylinder space 1 to the annular space 24 provided.

As mentioned, the arrangement of the relief valves 70a is, 71 in the hydraulic circuit unchanged in relation to the before explained execution example. Different ones are however the terminals P and 21 of the cylinder 10 connected: The pressure line 88, which is with the output of the pump 80 and the input of the upper pressure control valve 70a connected, leads to the terminal P1 of the cylinder 10, so that the annular groove 14b the bottom active pressure connected thereby stands, which amounts to in this embodiment again 100 bar. The terminal P of the cylinder 10 and thus the annular groove 14a are 92 connected to the overflow pipe, in which the pressure specified by the upper pressure control valve 71 prevails.

Because also in this embodiment an automatic pressure adjustment is not provided to varying those which can be absorbed measures, is the active dampers in accordance with Fig. 3 again preferably masses suitable constant to the attenuation.

The function of this Ausführungsbeispiels does not differ from the before explained embodiments. If the piston rod 21 an impact load affects in direction of arrow U, the pressures in the cylinder space 1 and the annular space 24 connected thereby rise first. Upper a connecting conduit 87 between the pressure line 91 and the cylinder space 1, in which preferably a non return valve 76 is, diverts oil so long into the pressure line 91, as the pressure in the cylinder space 1 exceeds the pressure in the pressure line 91. In this time moved itself the piston 20 in direction of arrow And. With completion the piston movement and diverting end to from the outside applied acceleration, so that subsequent pressurized oil flows over the conduit 88 into the annular space 24 and - over the balance drilling 28 and the blind bore 27 - which cylinder space 1 fills up again so far, until the tax edge 24a of the piston 20 takes the annular groove off 14b again. The active dampers has then its central position again achieved.

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If the piston rod 21 an acceleration affects in direction of arrow O, a vacuum develops in the cylinder space 1; by corresponding choice of the coverage of tax edge 24b and annular space 14a, which has preferably a small negative measure, oil can flow into the cylinder space 1 over the terminal P, so that the piston rod 21 can implement a movement in direction of arrow O. Immediate one after the release of the annular groove 14a flows then the oil full. After acceleration conclusion the piston rod 21 the bottom influence on its resting mass in direction of arrow U and displaced thereby the oil located in the cylinder space 1 over the terminal P, the conduit 92 and the upper pressure control valve of the 91 sinks again downward. As soon as the tax edge 24 the corresponding tax edge of the annular groove 14b achieved stands for it, it again in the central position.

In trains of the foregoing description it was subordinated that the vibrator at the piston rod 21 hinged and that the mass with the cylinder connected, which can be absorbed, is. In order to make significant that it depends alone on the relative movement between cylinders and pistons it is assumed, appended the vibrator at the cylinder 10 attacks and the mass which can be absorbed is to the piston rod 21 coupled.

The embodiment in accordance with Fig. 4 is an active damper with a simple acting cylinder and two-edge control as well as external pressure control. The pistons 20 disposed in the cylinder 10 possesses again a central disposed annular space 24, which becomes in axial direction of the two tax edges 24a, 24b limited. The tax edges co-operate also in the cylinder disposed annular grooves 14b, 14c. In the central position of the damper the two tax edges cover their associated in each case annular groove. At the floor of the cylinder is the annular groove 14a with associated terminal P, and at the head of the cylinder again the annular groove is 14d with terminal P provided. From the annular groove 14c a channel leads 13 to the annular groove 14d, in addition again the axial blind bore is 27 in the piston 20 provided, which stands over a throttle 26 with the annular space 24 in connection.

The pump 80 sucking in from the sump 84 promotes pressurized oil to the conduit 91, which is with the terminal P' three/three of directional valve 40 connected. From the conduit 91 a conduit 92 branches, those on the one hand to the terminal P1 of the cylinder 10 connected with the annular groove 14b and in addition to the pressure monitor and/or Relief valve 70 leads. The output of the relief valve is 93 connected to the return line, which again due to the non return valve 82 a bottom small excess pressure stands and in already before the described manner to the terminal T of the cylinder and over a branch line 94 also to the terminal the T' three/three-way valve connected is.

From the terminal P of the cylinder the pressure line leads 88 first to an actuating cylinder 42 for three/three directional valve 40 and other to a choke jet 50, from whose output a conduit 90 leads on the one hand to the other actuating cylinder 43 of the valve 40 and in addition to the input of a pressure governor 60, which is 93 connected over a leakage oil line to the return line. The terminal A three of the three-way valve 40 stands over a conduit 89 with the conduit 88 in connection.

The function of this embodiment corresponds to that of the damper in accordance with Fig. 5, so that first the constructional structure of the modified embodiment in accordance with Fig. 5 described will be.

This modification places a space saving compact execution of the damper in accordance with Fig. 4, with which three/three-way valve 40 together with the pressure governor 60 is and the choke jet 50 with the cylinder 10 to an assembly summarized and is in an approach 10a to the cylinder 10. The advantage of the embodiment after Fig. 5 exists among other things in the fact that only two external lines, the pressure line 91 and the return line 93 required become i.e., between which the pressure monitor 70 on the pressure side of the pump 80 and the pressure side of the valve 82 is.

Parallel one to the cylinder bore is in the approach 10a a stepped bore, are 40 accommodated in whom the pressure governor 60 and the control piston 41 of the valve one behind the other. Into the bore for the control piston 41 are axial offset two annular grooves 44a, 44b incorporated, of which the annular groove 44b is on the one hand with the terminal T' for the return line 93 and on the other hand over the channel 13 with the annular grooves 14c and 14d of the cylinder 10 connected. The annular groove 44a serves the pressure line 91 over the terminal P' of the control valve 40 and the internal terminal P1 of the cylinder 10 with the annular groove 14b for the connection. The two annular grooves 44a, 44b co-operate alternative with one tax edge each of the control piston 41, which by the lower and/or, upper flank of a pilot piston turning formed, those become for their part an annular space 45 in the valve 40 defined.

This annular space 45 stands over transverse bores 47 with a central bore 46 of the control piston 41 in connection, and the central bore 46 flows on the one hand to direct into a control cylinder 53 of the valve 40 as well as on the other hand over the choke jet 50 into the other control cylinder 54 of the valve 40.

By balance feathers/springs 55, 56 the control piston is 41 in its represented central position biased, so long the pressure in the two control cylinders 53, 54 same is.

The control cylinder 53, which is 51 outward self contained by means of a lid, possesses an internal output A, which is over an internal channel 15 with the terminal P of the cylinder 10 connected. The channel 15 in Fig. corresponds to 5 to the conduit 89 in Fig. 4 that the control piston 41 cleared away end of the control cylinder 54 stands for the pressure governor 60 with the memory cylinder 59 in connection, which exhibits in the memory cylinder 59 axial shiftable pistons 58 as well as a memory feather/spring 57, which push on the one hand at the piston 58 and on the other hand at a lid 52 away, with which the approach 10a interspersing stepped bore sealed is.

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The operation of the embodiments after the Fig. 4 and 5 - described at the embodiment specified last is the subsequent: If the not represented vibrator introduces an acceleration over the eye 12 of the cylinder 10 into the damper, a proportional pressure change results in the lower cylinder space 1, because the not represented mass connected to the eye 22 of the piston rod 21 wants their layer in the space due to its inertia maintained. Prerequisite of the proportionality is that piston 20 and piston rod are as frictionless as possible 21 opposite the cylinder 10 and lid 11 guided. The pressure increase in the cylinder 1, which corresponds to an acceleration in direction of arrow 0, leads three to a same pressure increase in the control cylinder 53 of the three-way valve 40, since the cylinders are 1 and 53 15 as throttle-free as possible connected over the channel. Due to its resilient storage the control piston 41 a pressure-proportional path in the direction of the pressure governor 60 shifts with the sequence that the annular groove 44b with the annular space becomes 45 connected. Thereby oil from the cylinder 1 can divert the central bore 46 of the control piston 41 and its transverse bore 47 over the control cylinder 53, into the return line 93; corresponding can move the Zjlín of the 10 upward, without raising the piston 20 thereby.

, The mass which can be absorbed connected with the piston will take part in the movement of the cylinder initiated of the vibrator thus not or only slight ones.

Thus an upward movement of the cylinder 10 opposite the piston 20 corresponds to the upward movement of the control piston 41; this relative movement between cylinder 10 and piston 20 leads to the fact that the piston opens 20 with its tax edge 24a the annular groove 24a, so that from the pump 80 coming and from the pressure monitor 70 the oil specified in its pressure can arrive over the conduit 91, the terminal P', the annular groove 44a and the other terminal P1 together with annular groove 14b into the annular space 24.

Upper in the conduit 91 dominant the pressure influences the throttle 26 and the bore 27 therefore on the cylinder space I. It can flow however so long no pressurized oil from the conduit 91 into the cylinder I, as the outside acceleration continues on the cylinder 10, because during this time the pressure is in the cylinder I of large as the pressure in line 91.

With acceleration end the control piston 41 stands again in Fig. 5 position shown, in which the annular space 45 is three/three-way valve of December return line 93 severed. Therefore also no other oil can divert more now from the cylinder space I. Since at this time however the annular groove 14b is further released, now the pressurized oil from the conduit flows 91 on the described path into the cylinder space I, whereby this again filled and the cylinder in direction of arrow become U displaced, until the tax edge 24a locks the annular groove 14b again and the cylinder 10 takes thus again its central position opposite the piston 20.

The movement of the control piston 41 required for to that extent described flow results to the choke jet 50 from the present one its. It effected that due to the outside acceleration a pressure developing in the control cylinder 53 cannot adjust itself simultaneous also in the control cylinder 54. The sequence is a Druckgefälle of the control cylinder 53 to the control cylinder 54, so that the control piston 41 can implement the described movement. It moved 56, and the volume displaced of it becomes thereby against the spring 60 stored in the pressure governor, whose memory feather/spring becomes 57 corresponding compressed. The resistance of the choke jet 50 must be with the fact so adjusted that the control piston 41 takes its drawn rest position the bottom influence of the spring forces and pressures only then again if the outside acceleration dropped to the value 0. Of it independent must become the natural frequency of the Messsystems in the ratio to the frequencies very large made which can be absorbed, so that the control piston 41 can follow the pressure changes practical delay-free. Also the performance of the hydraulic pump must be 80 sufficient large, in order to be able to deliver sufficient oil subsequently sufficient quick, if the cylinder 10 implements a movement in direction of arrow U opposite the piston 20. With the yilinderdurchmesser of 20 mm, a relative stroke between cylinders and pistons of 4-20 mm and a coupled cash of 300 kp (static) a capacity of the pump has itself 80 proven of $Q = 8\text{ L/min}$ than sufficient if the vibrators an acceleration in direction of arrow U, coupled with the cylinder 10, implements, drops the pressure in the cylinder space I proportional. Entsprechend reduced itself the pressure in the control cylinder 53. The pressure stored in the pressure monitor 60 pushes thereupon the control cylinder 41 downward, i.e. in Pfeilrichtung And. Due to this movement of the control piston the annular groove 44a with the annular space becomes 45 connected, so that pressurized oil from the conduit 91 knows the annular space 45 over the channel 15 into the cylinder space I influxes other into the control cylinder 53 and over the terminal P. Thereby the cylinder is 10 thus in the layer to follow the movement of the vibrator in direction of arrow U while its layer knows the measures coupled with the piston 20 maintained.

at the time of the conclusion of this acceleration, if the pressure in the cylinder space I has again from the pressure monitor 70 the set value achieved, the control piston 41 is again in the drawn layer, so that 91 into the cylinder space I do not flow other oil from the conduit kann on the other hand have the described movement of the piston 20 however to the fact guided that its tax edge 24b the annular groove 14c released and thus a connection of the cylinder space I over the bore 27, who throttle 26, which annular space 24, the annular groove 14c of the cylinder 10 and the annular groove 44b three/three-way valve 40 to the Rücklaufleitung 93 manufactured has. Thereby it is possible that so long oil from the cylinder space I in the return line 93 diverts, until the tax edge 24b locks the annular groove 14c again; this happens if the cylinder has 10 opposite the piston 20 again its Mittellage occupied. The velocity of this return into the central position becomes 26 certain in substantial of the resistance of the throttle.

As also in the first embodiments takes the active dampers in accordance with the Fig. 4 and 5 thus its constructional fixed starting position whenever an outside vibration in direction of arrow 0 or U were expenditure-absorbed. The dampers know additional for this level regulation notwendigen to that in accordance with the Fig. 4 and 5 in addition, an automatic pressure adjustment actual changing static loads make. Such an adaptation is desired, if with the arrangement different large static measures damped to become to be supposed. Such a case occurs for example if the damper in connection with a vehicle seat used is to become and the vehicle by different heavy drivers is driven.

If in these cases the measures resting on the piston 20 enlarged becomes, without thereby a jerky load works, the pressure rising in the cylinder space I becomes also in the cylinder space 54 three/three-way valve effective, because can become 50 neglected with slow pressure increases the resistance of the choke jet. The control piston 41 will not move, because the pressure on its two sides is same. On the other hand the piston 53 of the pressure governor 60 will shift itself a small amount against the force of the memory feather/spring 57. The sequence is that the piston 20 of the damper something can shift in direction of arrow U, so that its tax edge 24a releases the annular groove 14b with the sequence that pressurized oil of the conduit can flow 91 over the annular groove 44a and the terminal P1 into the annular space 24 and from there by the throttle 26 and the bore 27 through into the cylinder space I. The piston 20 becomes thereby again so far raised, until its tax edge 24a takes the annular groove off 14b in the constructional central position again. Thus the adaptation is achieved to the enlarged mass.

If in the other case the measures reduced becomes, the pressure in the cylinder space I sinks; the differential pressure in the control cylinders 53 and 54 three/three-way valve 40 remains itself (with small pressure changes) for zero and the piston 20 moved around a small amount upward. Its tax edge gives the annular groove 14c free to 24b, so that oil from the annular space can divert 24 - and thus from the cylinder space I - over the annular grooves 14c and 44b into the return line 93. Due to the reduced volume the piston 20 sinks again downward, until its tax edge 24b locks the ring groove 14c; it has then its central position again occupied.

By selection of the magnitude of the coverages of the control piston 41 with it the associated annular grooves 44a, 44b a certain insensitiveness of the damper can become opposite very small accelerations achieved in the rest of.

In Fig. 6 represented variant differs from the embodiment in accordance with Fig. 6 by the fact 4 that 31 used in place of the throttle planned there in the piston 26 here two external flow control valves become 30, which are in the embodiment 10 disposed outside of the cylinder however also into the cylinder integrated to be to be able. In addition becomes in the embodiment in accordance with Fig. 6 the tax edge 24b of the face of the piston 20 formed. Accordingly the associated annular groove 14c is in the range of the piston face, i.e. thus axial between the annular grooves 14a at the cylinder soil and 14b in the range of the annular space 24. Ein into the annular groove 14c flowing cylinder port P2 is by a conduit 97 with flow control valve 31 connected, whose opposite terminal leads across a conduit 96 to a cylinder port T1, which is more dber the annular groove 14d with the cylinder port T connected. The second flow control valve 30 is between the cylinder port P1 because of the annular groove 14b and leads across the pressure line 92 to the pump 80. The blind bore 27 in the piston 20 is in the present embodiment by means of a balance drilling 28 without additional throttle effect to the annular space 24 of the piston connected.

It concerns an active damper here thus likewise with a simple acting cylinder and two-edges control. The misalignment of the tax edge 24b to the piston soil brings the advantage that the axial dimension of the cylinder can become 10 reduced. In addition this embodiment offers the possibility to specify by corresponding choice of the resistance of the flow control valve 30 the speed of lift with the levels regulation during the method of the piston 20 from its lower end position into the central position independent of the respective static load whereby the present in each case pressure drop between the active operating pressure and the pressure is in the cylinder space I without importance. This again leads to the possibility of a decrease of the active pressure, which lies here for example at 110 bar. The sequence is a reduction of the hydraulic power dissipation and thus the oiler warming.

Also the adjustment rate of drop can be adjusted with this embodiment independent of the respective static load and without influence of the pressure drop between the cylinder spaces I and II (return). For this the other flow control valve serves 31. In all other respects the function of the embodiment is in accordance with Fig. 6 of same those the Fig. 4 and/or 5.

Also in Fig. 7 illustrated embodiment works with a simple applied cylinder with two-edge control. The two tax edges 24a, 24b are in same way disposed as in the embodiment in accordance with Fig. 3. Likewise unchanged is the circuit of the flow control valve 31 between the cylinder ports P2 and T1. The flow control valve 30 from Fig. 6 is in the present case by a second pump 81 replaced, whose delivery rate is smaller than that of the pump 80 and on the adjustment speed of lift for the level control between lower and position and central position of the piston 20 designed is. The smaller pump 81 is 92 connected, at a location, by means of a conduit 98 to the conduit, which is opposite the cylinder port P1 by a non return valve 73 and opposite the pressure regulating valve 70 by a non return valve 74 in a direction of flow delimited. Between the pressure line 91 and the pressure regulating valve 70 is third non return valve 75.

With the embodiment in accordance with Fig. 7 is the larger pump 80, whose delivery rate is 20 designed on the maximum departure speed of the piston which can be expected, in the center position three/three-way valve 40 on bypass connected. In particular with systems, which are not continuous vibrations and shocks exposed, a significant reduction of the power dissipation can be reached in this way.

The pumps 80, 81 are secured by the non return valves 74, 75 and the valve 70 pressure-moderate, whereby the pressure level can become almost reduced on the maximum static pressure, which is during the level control for raising that on the Kolbenstan ge 21 quiescent measures required. The Rückschlagventil 73 verhindert with a failure of the pressure supply a sudden impact-wise retraction of the piston 20 against its lower stop in the cylinder.

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The function of the remaining elements of the hydraulic circuit of the embodiment in accordance with Fig. corresponds to 7 to that of the embodiments after the Fig. also that does not change 4 to 6, and it above the hydraulic circuit CCIT Fig when using the control piston 41a. 7 separate as variant shown is.

In the embodiment of the arrangement in accordance with Fig. 8 simple acting, double applied piston/cylinder unit with square control used becomes. Different one of the described Ausführungen is provided here cylinders designated with 10 the ' with five annular grooves 14a to 14e, substantial for the function, of which the ring groove 14a to the conduit 88, the annular groove 14b over a conduit 100 to the annular groove 14d and the annular grooves 14c and 14e are finally to a conduit 99 and the annular groove 14d to the flow control valve 31 connected leading to the conduit 93.

With 20 ' designated pistons of this embodiment 24, 24 ' into altogether three piston portions divided are by means of two one behind the other located annular spaces. The annular space 24 the tax edge 24a, the annular space 24 is ' the tax edge 24c, the cylinder space I the tax edge 24b and the cylinder space II a tax edge 24d associated.

Prefered one becomes here as pressure-dependent control valve 40 ' four/three-way valve. In addition, the here described damper works with three/three-way valve and a control piston 41b, as it is shown with the indication alternatively ' separate within the circuit. The control valve 40 ' possesses four terminals A, B, P and T, of which the terminal is B sealed, while the three of other terminals the corresponding Fig. 4 is wired. Between that the annular grooves 14c and 14e interconnecting conduit 99 and the pressure line 92 the flow control valve 30 lies. The linking

up valve 82 in the return line, shown with the prior embodiments, 93 is in the embodiment in accordance with Fig. 6 let go away.

The special cylinder design of this embodiment possible in each piston position an unthrottled pressure connection to the cylinder spaces I and II.

If the cylinder 10' in direction of arrow U from its not represented upper end position lies itself downward moved, the annular groove 14c free, so that pressurized oil from the conduit can flow 92 over the flow control valve 30, the annular space 24 and the Boh rung 27 into the cylinder space I. If the cylinder becomes 10' in direction of arrow U moved other beyond the central position, the cylinder space I of the cylinder space II with pressurized oil supplied, over a balance drilling 28' in the piston rod 21, a blind bore 27', an other balance drilling 28', which flows into the annular space 24', from there over the then exposed annular groove 14d, a conduit 100 to the annular groove 14b and thus to the cylinder space I.

During the level control in the reverse sense, if the cylinder becomes 10' from its whole extended position in direction of arrow O moved, pressurized oil becomes from the cylinder space I over the conduit 100 into the annular space 24' and from there partial silver the flow control valve 31 as well as the other part by the bore 27 the cylinder space II as well as finally also in this way into the return line 93 conveyed.

All remaining members of this embodiment required for the active hydraulic attenuation correspond to those of the before described embodiments.

In Fig. 9 is simple acting, double applied piston/cylinder unit with two-edge control shown. Zy liner. 10 and piston 20 corresponds to a large extent to the embodiment of the Fig. 4; different is with the embodiment after Fig. 9 the channel 13 of the annular groove 14c to the cylinder port T and/or. the return line 93 by a conduit 86 replaced, in whose course the flow control valve is 31 disposed. The piston 20 differs from the embodiment to Fig. 4 through del abolishment of the choke jet 26, which becomes now 28 replaced by a balance drilling. Was added with the embodiment in accordance with Fig. 9 a plenum 79 in backel the 11' for leakage oil. This plenum possesses a leakage oil connection L, 93 connected over which it is with the return line.

When pressure regulating valve 40 finds " four/three-way valve application, which interconnect the cylinder spaces I and II in its drawn center position and in its two end positions in each case both cylinder spaces I, II either by its terminal T and the Leitung 94 connects with the return line 93 or however by its terminal P with the Druckleitung 91. In addition from the pressure line 91 the conduit 92 branches, which leads 30 to the annular groove 14b of the cylinder 10 across the other flow control valve.

The operation of this embodiment corresponds in principle to the before explained variants.

Fig. 10 finally an embodiment with double acting cylinder and square control shows up, an automatic pressure adjustment to if necessary the changing mass which can be absorbed in both traveling directions of the piston possible. For this purpose a double acting external pressure control is provided.

The cylinder 10' possesses a lid 11' at its two ends ever, 11' A in in connection with Fig. 9 described construction with one plenum each 79 together with zugehö cylinder port L riget. Further altogether five annular grooves 14a to 14e are into the inner wall of the cylinder in-stung and over one cylinder port each outward guided.

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The piston 20 " consists of three portions, again two annular spaces 24, one behind the other located in axial direction, 24 " compartments. The annular space 24 a with the cylinder space I and the annular space 24 " with the cylinder space II in the manner connected already described with other embodiments. The middle, the zwischden two annular spaces 24, 24 " located part of the piston 20 " cover also Tax edges 24b, 24c in the central position of the piston the annular groove 14e off. Those the annular spaces 24 and/or. 24 " course-turned ends of the outside piston members form tax edges 24a and/or. 24d, those in each case an annular groove 14b and/or. 14c in the piston central position take off.

The two itself axial outer opposite and the respective lids 11' and/or. 11' A adjacent annular grooves 14d and/or. 14a are over one conduit each 88, 88 " in each case a terminal B and/or. A four/two-way valve 40 " connected. In addition 14a leads a measuring conduit 101, 102 to a Abwegeventil 105 from everyone of the two annular grooves 14d and, whose output is over a conduit 103 to an actuating cylinder 43 of the valve 40 " and guided over the choke jet 50 also to the other actuating cylinder 42 of the valve 40 " the rear choke jet 50 the pressure governor is 60 connected, whose output T with the return line is 93 connected. The output T four/two-way valve is unbeschattet, and the terminal P is again over the conduit 91 because of the output of the pump 80. In of the represented rest positions of the active damper is all terminals A, B, T, P from each other separate; after actuation of the valve 40 " the terminals A and B are direct connected with one another and in addition common over a throttle 49 to the terminal P, i.e.

thus to the pressure line 91 placed.

In an alternative socket three/two-way valve with a control cylinder become 41c used, which is the same switching functions to implement in the layer as the control cylinder 41 " in the preferred embodiment.

The middle annular groove 14e is 93 connected over the flow control valve 31 and a conduit 104 with the return line.

The two annular grooves 14b, 14c are 99 to each other parallel connected by means of the conduit and more dber the Stromregelventil 30 and the conduit 92 with the pressure line 91 connected, from which in the multiple described manner a conduit branches to the input P of the relief valve 70, whose output is T again with the Rücklaufleitung 93 connected.

The operation of the implementing us example in accordance with Fig. 10 is the subsequent.

If on the piston rod the 21 and/or. 21a with being certain the cylinder, i.e. with quiescent vibrator in direction of arrow O slow increases, decreases the pressure in the cylinder space II likewise to and in the cylinder space I. The pressure differential is because of the inputs P, P' of the weighing valve 105. Der sich daraufhin in der Leitung 103 einstellende höhere Druck wirkt durch die Drosseldüse 50 hindurch auf die Druckwaage 60, so dass deren Kolben etwas gegen die Feder verschoben wird.

That has to the sequence that the piston 20 can implement " a corresponding movement in direction of arrow O and that its tax edge 24d releases the annular groove 14c. Simultaneous one gives the tax edge to 24b of the piston 20 " also the annular groove 14e free. Lettar effected that oil from the cylinder space I can divert 104 to the return line 93 over the annular space 24 and the flow control valve 31 as well as the conduit, during simultaneous however of the pump 80 over the conduits 91.

92, the flow control valve 30 and the conduit 99 pressurized oil over the annular space 24 " to the cylinder space II flows and the piston 20 " into direction of arrow U into the central position leads back. A slow increased mass, those on the piston rod 21 and/or. 21a in direction of arrow U with fixed cylinder influences, leads to the same sequence of functions in reverse direction.

If on the cylinder an acceleration affects 10 ' in direction of arrow O (or the piston 20 ' in direction of arrow U), which is to be absorbed, develops itself in the cylinder space I one ent speaking pressure peak, which affects 103 the actuating cylinder 43 over the conduit 102 and the weighing valve 105 as well as the conduit and brings these to the switching of the pressure regulating valve 40 " ', because the choke jet 50 an immediate pressure equalization opposite the actuating cylinder 42 prevented. The switching of the weighing valve 105 becomes in the rest of by the fact supported that a pressure drop in the cylinder space II corresponds to the pressure increase in the cylinder space I, which becomes over the conduit 101 also at the terminal P of the weighing valve 105 effective.

By the switching four/two-way valve 40 " "become the cylinder spaces I, II interconnected, so that out of the cylinder space I into the conduit 88 " diverting oil can flow by the valve 40 " through and over the conduit 88 into the cylinder space II. In addition diverting is over the throttle 49 within the valve 40 " and via the upper pressure control valve 70 possible. By the interconnection of the two cylinder spaces I and II the cylinder 10 ' first free in direction of arrow O can move and follow the vibration, without on the one which can be absorbed, the piston 20 " loading mass becomes a substantial force exerted.

The movement of the cylinder 10 ' after bben with in the space fixed dte that piston 20 " leads to the fact that the tax edge 24c of the piston the annular groove 14e and that the tax edge 24a the annular groove 14b releases. The Kohsequenz is that the cylinder space II is 93 connected over the annular space 24 ' and the flow control valve 31 as well as the conduit 104 with the return line, while it pressurized oil of the conduit becomes 91 over the throttle 49 and the conduit 88 supplied, which can divert over the conduit 104 again. In addition, the consequence is that pressurized oil clay/tonne of the conduit 91 over the conduit 92 can arrive and the Stromregelventil 30 as well as the annular groove 14b into the annular space 24 and from there into the cylinder space I and also flows, as soon as the pressure increase in the cylinder space, effected of the vibration, becomes smaller I as the active pressure at the terminal P of the upper pressure control valve 70.

Toward acceleration end the cylinder movement in direction of arrow O bottom co-operation of the flow control valve becomes 30 slow decelerated; the cylinder space I fills again, so that the cylinder becomes 10 ' returned into the central position, in which the different tax edges their annular grooves again takes off.

An acceleration of the cylinder 10 ' in direction of arrow U leads again to the same sequence of functions as before described and in both cases the affected higher pressure stored in the pressure governor 60 after the degradation of the pressure in the cylinder space I, increased by the acceleration, (and/or. in the cylinder space II) a recovery of the control valve 40 " in its drawn starting position.

This recovery becomes by those the actuating cylinder 42 associated and biased return spring supported.

The resetting speed of the piston 20 " becomes again 31 certain by the flow control valves 30, from which the first steers the temporal amount of the flowing pressurized oil in the described manner and from those the flow control

valve 31 the temporal diverting quantity into the conduit 104.

Preferred one in all other respects becomes that the flow control valve 31 on einenum approx. 10% in the Durchflußmenge lower value adjusted become than those flow control valve 30, whereby running ahead of the piston becomes 20 ° prevented during passive load effect.

L e r His Excellency i t e

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